MMOD-IMLI: Integrated Thermal Insulation and Micrometeoroid/Orbital Debris Protection, Phase I

Completed Technology Project (2011 - 2011)

Project Introduction

For NASA extended missions in Low Earth Orbit (LEO), Micrometeoroid and Orbital Debris (MMOD) protection for spacecraft, space stations and orbiting fuel depots is critical to mission safety. MMOD penetration is a risk for spacecraft and instruments; spacecraft designers must provide protection to minimize MMOD damage. Cryogenic propellants, and their thermal insulation, are also an important part of NASA's next generation vehicles. Orbital fuel depots must provide Zero Boiloff cryopropellant loss and maintain flightworthiness over extended missions in LEO. Quest & Ball have developed an innovative next generation MLI that could provide both high performance thermal insulation and light-weight MMOD protection. MMOD - Integrated MLI (MMOD-IMLI) uses precise layer spacing control from polymer spacers to provide the basis for an advanced multishock MMOD shield. MMOD-IMLI is a novel multi-layer system using IMLI with proprietary micromolded polymer spacers to control layer spacing and support high strength Nextel and Kevlar layers. IMLI has been proven to have 27% lower heat leak per layer than state-of-the-art MLI. MMOD-IMLI will use specific layer materials, thicknesses and layer spacing to provide excellent MMOD protection. Preliminary analysis indicates MMOD-IMLI will provide superior MMOD protection than Whipple or Stuffed Whipple shields, the current shields used on the ISS, with substantially lower mass and providing 95% Probability of No Penetration for an orbital fuel depot, while also providing higher thermal insulation than an equivalent number of layers of conventional MLI. This Phase I research will evaluate MMOD protection and thermal performance available from our IMLI technology, design MMOD-IMLI blanket/shields, build and test an MMOD-IMLI prototype for MMOD protection using hypervelocity impact tests and thermal performance via LN2 calorimetry, compare MMOD and heat leak results to those predicted, and determine feasibility of MMOD-IMLI.

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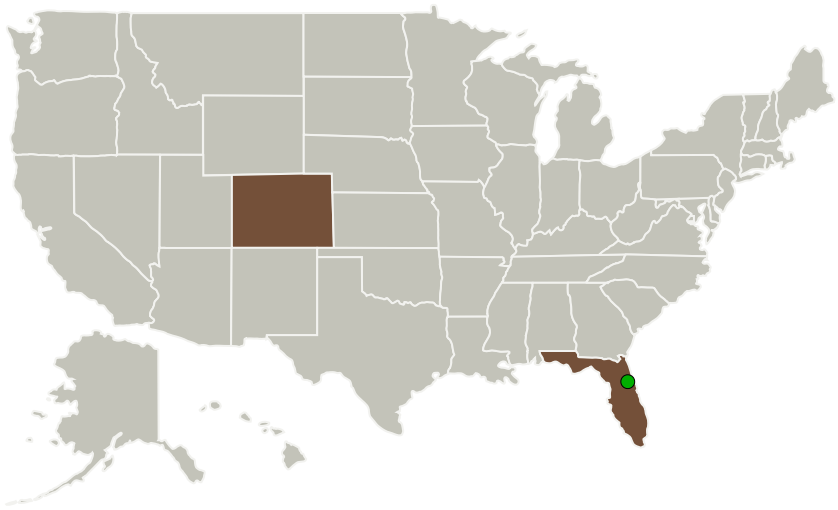
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Quest Thermal Group	Lead Organization	Industry	Arvada, Colorado
Kennedy Space Center(KSC)	Supporting Organization	NASA Center	Kennedy Space Center, Florida

Primary U.S. Work Locations	
Colorado	Florida

Project Transitions

February 2011: Project Start

September 2011: Closed out

Closeout Documentation:

- Final Summary Chart*(https://techport.nasa.gov/file/138313)*

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Quest Thermal Group

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Principal Investigator:

Scott A Dye

Co-Investigator:

Scott Dye

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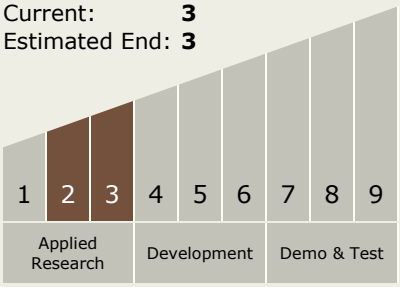
Technology Maturity (TRL)

Start: **2**
Current: **3**
Estimated End: **3**



Technology Areas

Primary:

- TX01 Propulsion Systems
  - TX01.2 Electric Space Propulsion
    - TX01.2.1 Integrated Systems and Ancillary Technologies

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System